CLAIMS

What is claimed is:

1. A method for producing olefins from light hydrocarbons, the method comprising:

(A) feeding a feed to a reactor comprising a catalyst, wherein the feed comprises oxygen and a carbonaceous material comprising carbon monoxide and a light hydrocarbon;

(B) contacting the feed to the catalyst in the reactor; and

(C) converting at least a portion of the light hydrocarbon with oxygen to at least one olefin, while simultaneously converting at least a portion of the carbonaceous material with oxygen to carbon dioxide to form a product stream comprising the at least one olefin and by-products, wherein the by-products comprise at least carbon monoxide.

2. The method of claim 1, wherein the feed has a molar ratio of oxygen to light hydrocarbon of about 3.5:1 or less.

3. The method of claim 1, wherein the feed has a molar ratio of oxygen to light hydrocarbon between 0.4:1 and 3.5:1.

4. The method of claim 1, wherein the feed has a carbon monoxide concentration from about 1 to about 45 mole percent.

5. The method of claim 1, wherein the feed has a carbon monoxide concentration from about 5 to about 35 mole percent.

6. The method of claim 1, wherein the feed further comprises hydrogen.

7. The method of claim 1, wherein the light hydrocarbon comprises one or more alkanes having between two and ten carbon atoms.

8. The method of claim 1, wherein the light hydrocarbon comprises one or more alkanes having between two and five carbon atoms.

9. The method of claim 1, wherein the light hydrocarbon comprises ethane.

10. The method of claim 1, further comprising mixing an oxygen feed, a carbon monoxide feed, and a light hydrocarbon feed to form the feed to the reactor.

11. The method of claim 1, wherein the catalyst comprises at least one metal selected from the group consisting of manganese, chromium, tin, copper, gold, oxides of such metals, and combinations thereof.

12. The method of claim 1, wherein the catalyst comprises a promoter selected from the group consisting of platinum, palladium, iridium, rhodium, ruthenium, and combinations thereof.

13. The method of claim 1, wherein the catalyst comprises a support selected from the group consisting of alumina, zirconia, silicon nitride, magnesium oxide, and combinations thereof.

14. The method of claim 1, wherein the feed is preheated before being fed to the reactor.

15. The method of claim 14, wherein the feed is preheated to about 600°C or less.

16. The method of claim 14, wherein the feed is preheated to about 450°C or less.

17. The method of claim 14, wherein the feed is preheated to about 300°C or less.

18. The method of claim 1, wherein the reactor operates at pressures of about 500 psig or less.

19. The method of claim 1, wherein the reactor operates at pressures between about 4 psig and about 300 psig.

20. The method of claim 1, wherein the reactor operates at a GHSV from about 20,000 hr^{-1} to about 10,000,000 hr^{-1}.

21. The method of claim 1, wherein the step (C) occurs in the reactor at a gas temperature from about 700 °C to about 1,500 °C.

22. The method of claim 1, wherein step (C) further comprises producing the at least one olefin with a light hydrocarbon conversion of at least about 40 percent, and an olefin selectivity of at least about 30 percent.

23. The method of claim 1, wherein step (C) further comprises producing the at least one olefin with a light hydrocarbon conversion of at least about 60 percent, and an olefin selectivity of at least about 50 percent.

24. The method of claim 1, wherein step (C) further comprises producing the at least one olefin with a light hydrocarbon conversion of at least about 65 percent, and an olefin selectivity of at least about 55 percent.

25. The method of claim 1, wherein step (C) further comprises producing the at least one olefin with a light hydrocarbon conversion of at least about 70 percent, and an olefin selectivity of at least about 60 percent.

26. The method of claim 1, wherein step (C) further comprises separating the at least one olefin from the by-products to form an olefin product.

27. The method of claim 26, wherein the at least one olefin is separated from the by-products by cryogenic separation.

28. The method of claim 1, wherein at least a portion of the product stream is recycled to the reactor.

29. The method of claim 28, wherein the molar ratio of the fresh feed to the product stream recycle is about 1:0.75 or less.

30. A method for the production of ethylene from ethane, the method comprising:

(A) feeding a reactor feed to a reactor comprising a catalyst, wherein the reactor feed comprises oxygen, carbon monoxide, and ethane;

(B) contacting the reactor feed with the catalyst;

(C) converting at least a portion of the reactor feed to form a product stream comprising ethylene; and

(D) recycling at least a portion of the product stream to the reactor.

31. The method of claim 30, further comprising passing the product stream through a separation unit to form an ethylene-enriched product and at least one CO-enriched by-product stream.

32. The method of claim 31, wherein step (D) comprises recycling the at least one CO-enriched by-product stream to the reactor.

33. The method of claim 30, wherein the concentration of the carbon monoxide in the reactor feed comprises from about 1 to about 45 mole percent.

34. The method of claim 30, wherein the reactor feed has a molar ratio of oxygen to ethane of about 3.5:1 or less.

35. A method for the production of ethylene from ethane, the method comprising:

(A) mixing an oxygen-containing gas and an ethane feed to form a fresh feed;

(B) combining the fresh feed with a stream comprising CO to form a reactor feed;

(C) feeding the reactor feed to a short contact time reactor containing a catalyst;

(D) contacting the reactor feed with the catalyst;

(E) converting at least a portion of the reactor feed with oxygen to form a product stream comprising ethylene and by-products, wherein the by-products include CO;

(F) separating the ethylene from the by-products to form a recycling stream and an ethylene product, wherein the recycling stream comprises CO; and

(G) sending the recycling stream comprising CO to step (B).

36. The method of claim 35, wherein the reactor feed has a molar ratio of oxygen to light hydrocarbon of about 3.5:1 or less.

37. The method of claim 35, wherein the reactor feed has a molar ratio of oxygen to light hydrocarbon between 0.4:1 and 3.5:1.

38. The method of claim 35, wherein the concentration of the carbon monoxide in the reactor feed comprises from about 1 to about 45 mole percent.

39. The method of claim 35, wherein the reactor feed is preheated before being fed to the reactor.

40. The method of claim 35, wherein the reactor operates at a GHSV from about 20,000 hr^{-1} to about 10,000,000 hr^{-1}.